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XXIX.—*Contributions to the Natural History of the Infusoria.* By A. Schneider*.

[With a Plate.]

I. *On Polytoma Uvella.*

Polytoma Uvella is given by Ehrenberg† as the only species of the genus *Polytoma*, and characterized in the following words:—"Animal e familia Monadinorum, ocello destitutum, ore terminali truncato, ciliis aut proboscide subtili flagelliforme duplici instructo natantibus solitariis antico, divisione spontanea decussata et imperfecta, multipartitum in Mori formam enascens, dein partitum et altera vice solitarium." In a subsequent passage he adds—"With regard to its organization the polygastric alimentary organs appeared distinctly. Besides these I perceived a larger contractile vesicle, which did not belong to the nutritive apparatus, and which appeared to be connected with the male sexual organs. Lastly, a large, free, white spot in the anterior part of the body, the outline of which could not be made out distinctly, but which pressed the stomachal sacs towards the hinder extremity, led to the supposition that a seminal gland existed in that place." After repeated failures he succeeded, but only by employing a magnifying power of 6–800 diameters, in seeing the little sacs of the posterior portion filled with indigo. Dujardin, apparently, has never examined *Polytoma* himself, as he could not repeat Ehrenberg's observations upon its mode of division‡, and I am unacquainted with any subsequent observations upon this creature.

* Translated from Müller's Archiv, 1854, p. 191.
† Die Infusorien als volkommene Organismen, &c., p. 24.
‡ Dujardin, Hist. Nat. Infusoires, p. 276.

As it appeared desirable that we should be better acquainted with the mode of division of *Polytoma,* I have made a series of observations upon this elegant creature, the results of which will be found in the following pages. The material for the investigation is easily obtained. *Polytoma Uvella* is to be met with in every puddle, in rain-water tanks, &c., and its rapid increase may readily be effected, by the putrefaction of animal or vegetable matters.

Polytoma Uvella is of an oval form; it is from $\frac{1}{200}$ to $\frac{1}{40}$ of an inch long, and about half that width. At one end, which, with Ehrenberg, we will call the anterior extremity, it bears two filaments as long or longer than the body. When the living animal is examined under a magnifying power of 300 diameters, the body appears to be bounded by a simple outline. But in many instances, and especially when a large specimen can be found at rest, it may be seen that the internal substance of the body is surrounded by a thin and perfectly clear membrane, from which it is separated by a distinct space. When the investing membrane is more closely attached, its existence may always be demonstrated by the employment of reagents to produce the contraction of the substance of the body: chromic acid and solution of iodine in chloride of zinc are the best substances to employ, the latter especially, as it at the same time communicates a brown colour to the internal sac (Pl. XI. fig. 2). Under certain circumstances, the investing membrane divides into minute granules, assuming when viewed from the side a regular necklace-like appearance (fig. 8). A reproduction of the membrane then takes place. The substance of the body is perfectly clear, with the same refractive properties as that of *Amœba.* About the middle lies a clear, globular nucleus, surrounded by a narrow, reddish halo. Dilute acids render this more distinct. At the anterior extremity, close to the margin, there are two reddish vesicles, the contractions of which may easily be recognised in individuals in a state of repose. The hinder extremity always contains a mass of granules, with dark outlines, which are not altered by acetic acid. A weak solution of iodine in iodide of potassium gives them a deep blue colour, generally verging upon black, as it is difficult to hit the right quantity of the reagent to be added. The fine blue colour is better attained by the addition of diluted solution of iodine in chloride of zinc, as with this the granules become slightly liquefied, and when left standing for some time even form a blue paste. Muriatic and sulphuric acids also dissolve them, so that the subsequent addition of iodine gives the whole body a blue colour. When the putrefaction of the infusion is going on very rapidly, the granules fill the entire body. They are not arranged in balls like the nutritive matter in the bodies of other Infusoria, and it is by no means probable that they are taken in from the exterior. Besides the two contractile vesicles, single, non-contractile, reddish vacuoles are seen scattered through the substance of the body.

The starch-like granules are often converted into an indigo-blue pigment, which is then partially dissolved, and colours the whole parenchyma. Such specimens as these still retain the power of division, so that there can be no doubt as to their identity with *Polytoma Uvella.* Individuals were also frequently met with of which the substance of the body was of a uniform green colour, but which in other respects agreed exactly with *Polytoma.*

Deviations from this normal form never occur singly in the same vessel, but always make their appearance simultaneously in a great number of individuals. Certain peculiarities of their abode appear therefore to have an influence upon the form. Very compressed forms are rare. However, it not unfrequently happens that whilst the investing membrane retains its normal form, the substance of the body is not equally distributed in its interior. Sometimes it lies to one side, so as to fill only half the interior of the sac; sometimes it is entirely collected in the anterior, and sometimes in the posterior extremity; in the latter case it is connected with the anterior extremity by a slender filament (figs. 13 & 14). In infusions in which fermentation has long ceased, and which contain a large quantity of brown humus-like matter, but very small portions of nitrogenous substances in solution, the two last modifications of the parenchyma are most frequently met with. At the same time the starch-like granules disappear, the substance of the body acquires a darker, fatty outline, and finally disappears, with formation of the well-known large vacuoles.

The movements of *Polytoma* are the same as those usually ascribed to organisms furnished with two filaments. Whilst in motion the filaments are always in front, the animal rotates upon its axis, and this again describes circular vibrations upon a central point. If a movement in the opposite direction is taking place, the animal is endeavouring to turn the anterior extremity, and until this is effected, it swims backwards. When a drop of the infusion has been left for a few minutes upon a glass plate covered over with a piece of thin glass, a considerable number of the animals will be found attached to both glasses by their anterior extremity; the filaments are free, and it is probably by their vibration that the hinder extremity is made to oscillate in the direction of the plane of the two filaments. They collect in the same manner in crowds upon aquatic plants, as well as upon the sides of the vessel containing them. Their mode of attachment is still unintelligible to me. In any case some contrivance for this purpose, however simple, must exist either between the two filaments, or at the side of their points of issue from the membrane.

Reproduction.

During the swarming state a division of the substance of the body goes on uninterruptedly, at all hours of the day. The different stages of this process follow one another with greater or less rapidity in proportion as the conditions of nutrition are more or less favourable. Soon after the commencement of fermentation in an infusion, the rate of increase attains its maximum; it then diminishes as the fermentation ceases, the offspring at the same time undergoing a diminution of size.

The commencement of the process of division is indicated by the uniform distribution of the granular substance. A constriction of the substance then takes place, usually commencing on one side; by this the body is divided into two parts, which are still enclosed in the uninjured investing membrane. Simultaneously with, or perhaps before the completion of this bisection, the nucleus also divides (fig. 3). Although no constriction of the nucleus was ever noticed, nothing certainly was observed to contradict the supposition, that the second nucleus was produced in this mamner. The two halves then become constricted from their surfaces of contact, in such a manner that the constriction of one half crosses that of the other at right angles (fig. 4). To every depression thus produced on the one side there is a corresponding elevation of the other. The quadrisection (figs. 4 & 5) then takes place suddenly as if by cutting, and without any appearance of a circular constriction, each portion containing its proper nucleus. The divisions now acquire an oval form, and arrange themselves in such a manner that the ends of the posterior pair, which are turned towards the middle, alternate with those of the anterior pair in the same place (fig. 6). In very favourable circumstances (as for instance, at the commencement of fermentation), a third division into eight parts takes place, each division being still furnished with a nucleus. As a general rule, however, the young individuals acquire filaments soon after the quadrisection, and move about in various directions within the investing membrane, until this bursts, and the young, which are exactly like the mother except in their smaller size, are set free. In favourable circumstances the empty membrane remains with the two filaments. After the division of the substance into four or eight parts, the investing membrane is always visible without the employment of any reagents. This has not escaped Ehrenberg (*loc. cit.* and tab. I. xxxii.); he explains the appearance as a consequence of a superficial constriction. The filaments of the parent always appear to be connected only with one of the young individuals, although this is less distinguishable in the present mode of division than in that about to be described.

In this the quadrisection takes place in another manner. After bisection, the two portions shift their position in such a manner, that the surfaces of contact form a distinct angle with their original position. If this change of position be but trifling, the quadrisection goes forward nearly in the manner just described, and the arrangement of the developed young only differs as far as is rendered necessary by this change of position (figs. 11 & 12). But if it be more considerable, the new surfaces of division run parallel to each other and nearly perpendicular to the surfaces of contact of the two halves. The position of the young individuals is then completely different from that seen in the preceding case; all four lie parallel to each other, with their longitudinal axis oblique as regards the axis of the whole (figs. 9 & 10).

This difference may perhaps be explained as follows:—each portion has a tendency to acquire an oval form, so that soon after the bisection the anterior portion extends itself posteriorly, and the posterior towards the front. When sufficient time has not elapsed for the one dimension to predominate over the other, the quadrisection takes place as in the former case; but when, on the other hand, one dimension has become predominant, the division into four takes place in accordance with the same law as the original division into two.

The method of division first described is always met with in the early periods of an infusion, which are most favourable to the development of the creatures. Towards the end the latter mode alone occurs. This phænomenon was so remarkable, that on the first occasion of my examining an infusion towards the close of its action, I imagined that I had at first misunderstood the mode of division.

Under certain circumstances the individuals pass to a state of rest. They are then completely filled with the starch-like granules, so that the nucleus only appears as a reddish spot. The substance of the body becomes spherical, and invests itself with a membrane which is frequently of considerable thickness (fig. 7). In this state I have never observed them to undergo any division or any other change, and when dried the cysts still retain their contents. When clear water is poured over them they do not return to life, but would probably do so in a fermenting infusion.

The mode in which the swarming individuals arrive at this state of repose appears to be as follows. The filaments are gradually shortened, their substance collecting at the free extremity in the form of a small knob, until at last the filiform portion entirely disappears, and in place of the filaments, two vesicles are seen at the anterior extremity of the investing membrane (fig. 15). I have observed a similar contractibility of the substance of the filaments in a *Bodo* which is most nearly allied to *Bodo grandis*, Ehrbg. As this possesses not three filaments only, as seen by Focke (Ehrbg. p. 34), but often as many as five, the vesicles produced in this manner cannot easily be overlooked. I cannot however state with certainty, whether all the individuals which undergo this change invest themselves with cysts. When infusions containing *Polytoma* are dried slowly, individuals with the vesicles just described are found in the deposit, but no cysts, and it is not impossible that such individuals may assist in the continuation of the species in some other way.

Nearly allied to *Polytoma* is the *Chlorogonium euchlorum* of Ehrenberg *, which consists of a firm, transparent, fusiform investing membrane, with which I was not able to obtain any reaction for cellulose. Its interior is filled with a homogeneous green mass, which is generally somewhat rounded behind; the green colour disappears in front, where the mass is distinctly connected with the filaments inserted in the apex. In the middle there is a transparent, round nucleus, the reddish halo surrounding which is extended in a spindle shape towards the two extremities. The surface of the green mass is completely covered with reddish spots (as many as twelve), but none of these are of such a fine red colour as the eye-spot of *Euglena*.

Ehrenberg describes *Chlorogonium* as possessing an eye; he says,—"The eye of *Chlorogonium* is very distinctly marked, but very minute, so that it may easily be overlooked." Unfortunately during my observations upon this creature I had not Ehrenberg's work at hand; I cannot however call to mind that one of the reddish spots was unusually distinct. I could not discover a contractile space; but if this were no larger than in *Polytoma*, it would require uncommon acuteness of vision to distinguish it from the non-contractile reddish spots. Division takes place in the interior of the investing membrane, in exactly the same manner as in *Polytoma*. The number of individuals produced is never less than four, but often as many as thirty-two—in the latter case they are very small, but always resemble the parent in other respects. A spherical state of rest also occurs. It appears that when the requisite conditions are present, the young proceeding from the division of the parent pass into this state immediately after they are set free; their soft investing membrane probably rendering them fitter for this

* P. 114. tab. VII. fig. XVII.

purpose. The contractions which then take place are probably the same that were observed by Ehrenberg. In other respects I have found the form quite unchangeable, and *Chlorogonium* must consequently be separated from the *Astasiæa*, amongst which it has hitherto been arranged. On the addition of iodine only a few blue granules are to be seen in the fusiform individuals; the green spheres, on the contrary, which are completely filled with green granules, acquire a deep blue colour with this reagent: if the colouring matter be destroyed by means of concentrated sulphuric acid, the granules are dissolved, and on the addition of iodine a beautiful blue colour is produced. By long keeping the green of the cysts passes to red. The cysts are not to be roused from their torpid state by the production of fermentation. I have, however, observed their revivification under other circumstances, but my materials are insufficient to enable me to describe the mode of reproduction of the investing membrane and filaments, which would certainly be interesting. The conditions required for the existence of *Chlorogonium* are apparently quite different from those of *Polytoma*; the former did not multiply abundantly in infusions until the latter had passed to the state of repose.

To show how very different is the mode of division in other *Monadina*, in which the investing membrane is deficient, we may refer to *Chilomonas paramecium*, Ehrbg. (p. 30. tab. II. fig. vi.). The form of this animal is subject to considerable variation. It usually presents a longish oval, broader at one end than at the other. At the broader end, a little to one side of the apex, there is a small indentation, in which the two filaments are placed. The interior is principally filled with round granules (as represented by Ehrenberg), which distinctly exhibit the reactions of starch. In the hinder portion a clear nucleus with a reddish halo may be observed. The oval is but rarely perfect; it is generally flattened on two sides, and the surfaces thus produced are even somewhat impressed in a longitudinal direction. It is to this impression, I think, that the reddish colour which makes its appearance when the animal is examined lying flat before the observer, is to be ascribed. I could discover no contractile space, although a reddish vesicle certainly does always exist in the anterior extremity; I must, however, leave its contractibility an undecided point. Ehrenberg mentions expressly, that *Chilomonas paramecium* never could be made to take in coloured nourishment, nor have I been able to observe this any more than with *Polytoma*.

Whatever number of these animals may be observed, no trace of division will ever be remarked in them. Very rarely we may see two individuals adhering by their middle, evidently produced by a longitudinal division. We shall endeavour to explain this.

On close examination, one or two reddish lines may be seen running backwards from the bottom of the indentation (fig. 25), which might readily be taken for organs lying in the interior of the body. I have convinced myself, however, especially by the comparison of the process of division in a species of *Bodo,* that these lines indicate furrows, which gradually divide the whole by cutting deeper and deeper on each side. As during this process the animal undergoes no change of form, except in becoming a little broader, and the division takes place along its whole length, the process must readily escape observation. The anterior end is always a little thicker; the furrows consequently are deeper and more distinctly recognizable in that part. With a suitable arrangement of the microscope, it is evident that, the two furrows being looked at simultaneously, two reddish lines are seen. It is only in rare cases, when the division has taken place more slowly in some particular spot, that the two specimens must endeavour to tear themselves free, and thus, by twisting in contrary directions, draw our attention to them. That the process of division is effected in a similar manner in other *Monadina,* appears from an observation of Ehrenberg's upon *Cryptomonas cylindrica* (p. 42):—"I saw no instance of constriction or fissation, but two individuals were swimming whilst adhering together, which might lead one to suppose that a longitudinal division from behind forwards had taken place." And it is not improbable that the specimen represented by him on tab. II. fig. xix. 2, with two seminal glands (nuclei ?) and two longitudinal lines, was in the act of division.

The occurrence of an encysted or quiescent state in *Polytoma* cannot be considered remarkable, since Stein has made known the encystation of *Vorticella microstoma**, and Cohn that of *Trachelius Ovum, Trachelocerca Olor, Holophrya Ovum, Prorodon teres* and *Chilodon uncinatus*†. To this list I can add some others from my own observations. *Stylonychia pustulata,* Ehrbg., gradually acquires a spherical form, still retaining its cilia; the cilia then quickly fall off, continual little contractions take place, and a clear mucus is secreted by the whole surface, which gradually hardens into a strong, solid membrane. When a spherical specimen is obtained, the casting off of the cilia and the secretion of the membrane may easily be followed under the microscope. The exclusion of the animal completely furnished with cilia may often be observed, merely by re-establishing fermentation in the fluid. The animals which are somewhat elongated previously twist round spirally with great rapidity within the cyst. After exclusion, they present a remarkable resemblance to

* Wiegmann's Archiv, 1848.

† Siebold und Kölliker's Zeitschrift, iv.

Oxytricha caudata, Ehrbg. (tab. XL. fig. xi.), although I will not say that they are perfectly identical; the posterior extremity in particular is always bent round in the manner represented by Ehrenberg at No. 3 of the figure just cited.

Euplotes Charon, Ehrbg., contracts itself within its shield-shaped carapace into a ball, which then invests itself with a new membrane. As long as the carapace, which is distinguished by its striæ, is still retained, there can be no doubt as to the animal enclosed in the cyst. The cysts of both these Infusoria are, as might be expected, very common in infusions, and are probably often confounded with the cysts of *Vorticella.*

Pontotrichum lagenella forms a cyst like that of *Trachelius* described by Cohn (*op. cit. supra,* p. 267), which completely retains the flask-like form of the body. Within this the animal contracts itself into a ball and invests itself with a new membrane. *Amœba* also actually has a state of rest. I observed it become round on one side, on which a firm membrane was then formed, whilst the other portion continued its peculiar movements. By degrees the membrane extends itself over the whole body, the moveable portion constantly becoming smaller, until at last a completely closed cyst is produced, in the clear interior of which a round nucleus with a reddish halo, exactly like that of *Polytoma* and other *Monadina,* may be distinctly observed*.

During our investigation of *Polytoma,* we have always tacitly regarded it as of animal nature. But if we consider how very difficult it is, in the present state of our knowledge, to draw the boundary-line between the animal and vegetable kingdoms, it becomes necessary to inquire with what right we have done so. If the cycle of development of *Polytoma* be completed by the forms now known, it is clear, in the first place, that *Polytoma* behaves very like a simple cell. A structureless membrane invests a soft, membraneless substance, which is continued externally in the form of a pair of filaments. The nucleus behaves like a cell-nucleus. It is true that if it be necessary that the nucleus of an animal cell should be a vesicle, the nucleus of *Polytoma* does not fulfil this condition. But is the proper membrane a necessary element of the animal cell-nucleus? Is it not possible that this may be formed only under certain circumstances? In the nucleus of *Amœba,* I have often observed, on the outer surface of the reddish halo, granulations which united to form a closed membrane; whilst at other times the nucleus exactly resembled that of *Polytoma.*

* I take this opportunity of calling attention to this nucleus, which, as far as I am aware, has not yet been noticed. By the comparison of numerous specimens, its constant appearance will distinguish it from enclosed particles of food. It occurs in *A. diffluens* and *radiosa.*

So that if it be considered possible that contractile spaces may occur in a primordial vesicle without the necessity for a peculiar apparatus of contractile fibres, *Polytoma* fulfils all the requisite conditions of a cell.

That *Polytoma* is an animal may be maintained upon two grounds.

1. *The constitution of the investing membrane.*—As soon as the starch-like granules have been destroyed by the long action of concentrated sulphuric acid, no part of the creature is coloured blue by iodine. Now we have no more reason for believing that the vegetable cell-membrane *must* necessarily consist of cellulose, than that the animal cell-membrane should *not* consist of that substance, so that we are still compelled to seek for other characters for their distinction. These would be—

2. *The contractile spaces.*—A statement of Cohn's * has certainly rendered it doubtful, whether the occurrence of these is henceforward to be regarded as an essential indication of an animal nature. He says, "On the other hand, certain genera of Algæ exhibit a stage of development, in which, in external form, in the absence of a cellulose membrane, in the distinct existence of ciliary organs of motion, red eye-like spots, vacuoles, and, according to a very recent discovery, *of internal pulsating spaces,* they undoubtedly appear very similar to the Astomatous Infusoria." If these pulsating spaces occur only in unicellular Algæ provided with cilia, these perhaps should properly be restored to their place amongst animals, notwithstanding the subsequent appearance of cellulose-membrane upon them. But if they occur in the swarm-cells of the Confervæ, they certainly cease to be a characteristic of animal nature. Thus, if we are not yet in a position to refer *Polytoma* with perfect certainty to its proper place, there is decidedly no reason for excluding it from the animal kingdom. We will not, however, venture to consider the Infusoria furnished with a mouth (*Stomatoda,* Von Siebold), as formed, like *Polytoma,* upon the type of a simple cell; for, high as we may rate the advantage accruing to science from the comparison of the Protozoa with simple cells, difficulties stand in the way of its complete application in the case of animals of such complicated structure as the *Vorticellæ* for example; and these cannot be considered as entirely done away with, until the history of their development has furnished proof that at no period does a fusion of several cells take place.

In conclusion we bring together the results of the investigation as shortly as possible.

* Zwanzigster Jahresbericht der schlesischen Gesellschaft für vaterländische Cultur, 1852, p. 46.

1. *Polytoma* is an animal.

2. It is characterized by a clear investing membrane, which does not consist of cellulose; two contractile spaces in the substance of the body; a nucleus with a nucleolus; two filaments; and by the deposition of layers of starch-like granules.

3. The starch-granules may become converted into a blue or green colouring matter.

4. *Polytoma* divides within the investing membrane into two, four, or eight parts, and propagates itself in this manner.

5. It passes into a state of repose.

II. *Difflugia Enchelys*, Ehrenberg.

A Rhizopod occurred in company with *Polytoma* in all infusions, the description of which will show, how very readily it might be supposed to be produced by a metamorphosis of the latter animal. Unfortunately I cannot confirm this supposition, and must confine myself to recording the fact. From its extraordinary transparency the examination of this creature was not without interest.

The Rhizopod in question has a transparent, membranous case, of an oval form, somewhat spherical on one side. The substance of the body is either attached uniformly to the interior of this case, or lies detached from it in various forms (figs. 16, 17, 18, 19). The substance of the body projects from the narrower end of the case, forming that moveable portion, which may be shortly characterized as the *foot*. In the hinder end there is a round, reddish nucleus, with a white nucleolus, which is only distinguished from that of *Polytoma* by the greater breadth of the reddish halo. The *foot* can exhibit the most various forms. In its simplest state it is nothing but a transparent globule, which afterwards divides into two or more smaller ones. From these smaller processes are given off, and sometimes an indefinite number of tentacles with acute or rounded extremities is formed. These tentacles are frequently drawn out to such an extent as only to present the appearance of thin rays. Sometimes also the foot is branched, and then usually encloses granules of foreign matter in its ramifications. The reception of nourishment is probably effected by means of the foot, in exactly the same manner as in *Amœba*. The granules of food occur at first only in the anterior portion of the substance of the body, which then usually has a folded appearance, while the hinder portion remains full and round. By degrees the whole body becomes filled, and the nucleus almost concealed. Vacuoles are seen in all parts. The contractile spaces are probably only concealed from sight, but I was unable to discover them.

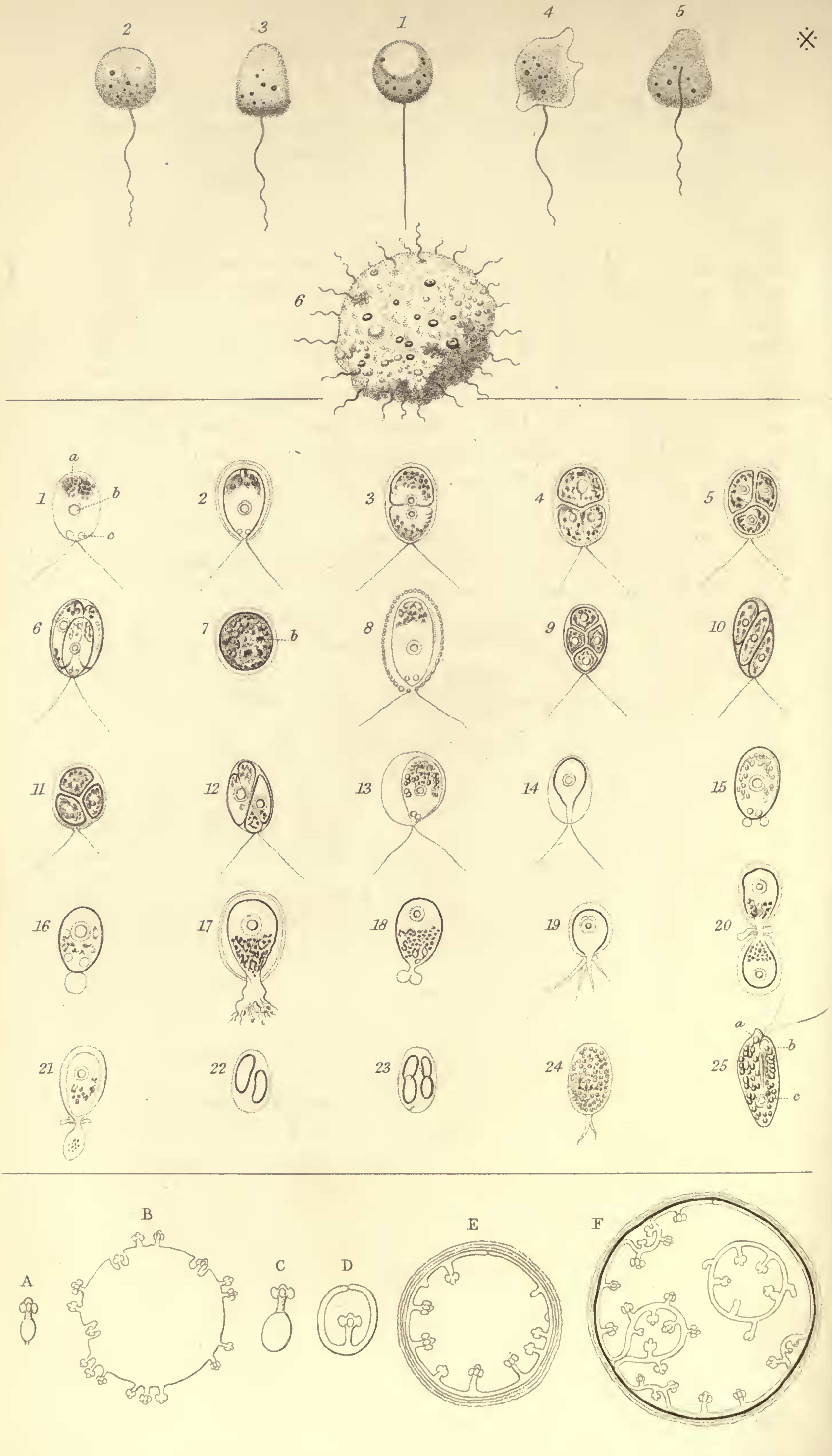
The Rhizopod just described is probably identical with Ehrenberg's *Difflugia Enchelys*. This is characterized as follows:—"D. minima, lorica ovata, dorso rotundato, glabra, pellucida, hyalina, 46 tam lineæ partem longa, processibus hyalinis, tenuibus, parvis, apertura laterali." This description, as well as the figure (tab. IX. fig. iv.), agrees very well with our animal, except the "lateral opening." The form or position of the foot may, however, cause the opening to appear as lying more towards one side.

True double animals of our *D. Enchelys* are frequently met with,—two bodies with membranous cases and nuclei being attached to a common foot (fig. 20). The foot very often consists only of a thin thread, but in other cases it exhibits all the forms which have been described as belonging to the foot of the simple animal. Both bodies are well filled with food. Three, four or five bodies are frequently seen hanging together in the same manner; these however are by no means in the same plane, but stand out from the foot in various directions. If these animals are obtained in considerable numbers, the formation of these colonies by gemmation may easily be observed. The foot is seen gradually to increase in size and acquire an oval form. A new investing membrane and nucleus are then formed. The offset is always equal to the parent animal in size. Like the foot of a single animal, the common foot of two or more is, as might be supposed, still in a condition to form offsets.

A similar adhesion of Rhizopoda has already been frequently observed. Cohn, in his 'Beiträge zur Entwickelungsgeschichte der Infusorien *,' has brought together the instances of this in a note, and conjectures that this adhesion is preparatory to a copulation; but may we not rather suppose that a gemmation like that of *D. Enchelys* also takes place in other Rhizopoda? With Perty and Cohn I have also seen a pair of *Arcella vulgaris* attached to one another by their openings, of which one, exactly as was observed by those naturalists, was provided with a white, the other with a yellow shell. The white shell is probably newly formed, and therefore indicates the young specimen produced by gemmation from its companion.

I have observed another mode of propagation in our *Difflugia*, and although my observations have certainly not been frequent, they have been sufficiently satisfactory. After I had kept a great number of these creatures for some weeks in a clayey sediment, the substance of the body, in all the individuals, contracted into a ball. All foreign substances had previously disappeared. The ball, which had a fatty outline, then divided into

* Siebold und Kölliker's Zeitschrift, iv. p. 261.



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